

## THE INTERACTIVE DIGITAL VIDEO INTERFACE

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A commonly heard complaint in the computer-oriented trade journals is that current hardware technology is progressing so quickly that software developers cannot keep up. As a result, it seems that available applications are always several generations behind in implementing current hardware capabilities. A good example of this phenomenon can be seen in the field of microcomputer graphics.

Today's price/performance ratio is such that an affordable personal computer for a sophisticated user may contain a 32-bit microprocessor operating in the range of 3-4 million instructions per second, an advanced graphics controller capable of 1024x1024 resolution with 256 colors simultaneously displayable from a palette of 16 million possibilities, 2-16 megabytes of RAM and an optical storage device capable of storing 600-800 megabytes of data. Such a system can be purchased today for a price of \$10,000 to \$15,000. The cost for a similarly configured machine 4 years from now can be expected to drop to the \$3000-\$4000 range. The physical dimensions of such a machine may shrink from desktop proportions to briefcase size, or smaller.

Such computer systems have the potential for effective storage of, and easy access to, massive amounts of textual and image information. A single optical disk can store all of the text and images contained within a typical set of encyclopedias while providing relatively quick access to any particular information of interest. Optical storage media will most probably supplant many of today's printed forms of publishing.

To effectively exploit the advantages of new mechanisms of information storage and retrieval, new approaches must be made towards incorporating existing programs as well as developing entirely new applications. There exists a great need to integrate more sophisticated graphics into applications and to take a wider view of how that integration can take form.

A particular area of need is the correlation of discrete image elements to textual information. The interactive digital video (IDV) interface embodies a new concept in software design which addresses these needs. The IDV interface is a patented device- and language-independent process for identifying unique image features on a digital video display and which allows a number of different processes to be keyed to that identification. Its specific capabilities include the correlation of discrete image elements to relevant text information and the correlation of these image features to other images as well as to program control mechanisms (fig.1). Very sophisticated interrelationships can be set up between images, text and program control mechanisms using this process.

I originally developed this process during the design of a microcomputer-based interactive atlas of medical histology (histology is the study of microscopic anatomy). Using this system, a medical student can call up from a menu a microscopic image from one of the body's organ or tissue systems. This image is then displayed on the video monitor with no labels or identifying structure names shown. The student can then use a mouse to indicate a particular image area that

he or she would like more information about. Clicking one of the mouse buttons causes the computer to display a screen of explanatory text concerning the particular histological structure indicated (e.g., an individual cell in an image of a group of cells). Pressing the other mouse button would cause the display of a higher-magnification image of that image element (histological structure) selected. The student is then free to interact with this higher-magnification image to obtain further textual explanation or to see even higher magnification views. It should be noted here that this "zooming" capability does not merely involve the higher-magnification display of the same digital image (with the resultant loss of resolution), but rather causes the display of an entirely different image with no decay in resolution or image quality. For example, if the on-screen image was of a 1000X light microscopic view of some tissue, selecting the "zoom" feature would cause the display of a low-magnification (3500X) electron microscopic image of that particular type of structure. These correlations can be caused to run in reverse, so that the student could zoom from high magnifications to lower magnification views or he or she could enter the name of a structure from the keyboard with the resultant display of an image containing the highlighted structure on the video display.

Image databases adapted for the IDV interface are extremely memory-efficient. The data storage load for a single image and correlation mechanism is less than 1% larger than the original compressed image file before adaptation to the system. It is therefore practical to include all of the 1200 or so images needed for a complete histology atlas on a single CD-Rom disk. Another advantage to the process is that it runs very quickly, and this speed is not affected by the resolution of the image. The histology atlas runs very fast on an unadorned IBM PC (4.77 Mhz) with the appropriate graphics controller and disk storage device. Although the images in the atlas are only 512x484 pixels in resolution, the program would achieve the feature identification just as quickly if the image resolution were 4000x4000 pixels.

A specific objective in the development of the Interactive Atlas of Histology was to eliminate the distraction of having all of the important discrete elements within an image labeled on the screen and yet maintain the capability for immediate access to the exact descriptive textual information which the student desires.

In some situations, computer graphic images can contain so much information that it is not practical or not necessary to see all of the text-based information relevant to a particular image. Such a case exists in the graphic display of supercomputer-level image output. The IDV interface could be of great practical value in allowing the scientist to interact directly with the graphic display of, for example, a complex biological process simulation. A custom-designed interface could allow the researcher direct and immediate control over program flow for a simulation while it is executing, or immediate textual elaboration on an interesting feature of the simulation output display.

Head-up displays are currently of great interest in the aerospace industry. These displays have the effect of placing the user within the virtual environment of the computer image. A great deal of research is being done towards making the user interface for such a display as intuitive as possible. Techniques such as retinal scanning are being investigated as possible means to achieve a very natural-feeling way to specify a location within the display. The IDV interface would be an effective way to correlate this intuitive locator mechanism to desired relevant computer responses.

Other possible applications for the process are numerous: computer-aided education for information-intensive fields such as medicine or the military, for the earliest educational levels or

for remedial or special education; image-based reference works such as atlases, catalogs, maps or navigation systems; cognitive rehabilitation systems, for head injury or Alzheimer's patients, to build associative relationships and still allow a controllable degree of freedom of interaction; interactive art displays; foreign language education systems; and entertainment programs or games.

The IDV interface is an attempt to redefine the role that computer graphic display images play in the function and purpose of application programs. It extends the concept of interaction to allow a user to interface directly with an image and not be distracted by unwanted information or the mechanics of computer operation. Although my own interests in developing applications with this process are limited to educational computing, it is my hope that others will undertake to explore its integration into the myriad of possible interactive graphic applications for which it is so aptly suited.

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OF POOR QUALITY

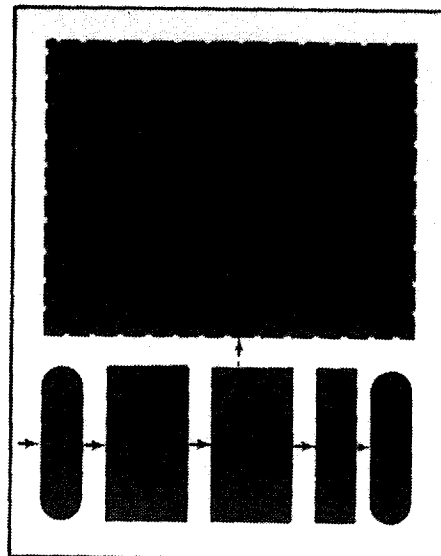
Relevant Textual  
Information

INTERFOLLICULAR LYMPHATIC ENDOTHELIUM

The interfollicular lymphatic capillaries have a thin walled endothelial lining. This lining displays a discontinuous basal lamina, anchoring filaments and a lack of fenestrations when viewed at the ultrastructural level.



Original Image  
Element



Program-Flow  
Control Mechanisms



Other Images

Figure 1.- The IDV interface allows very sophisticated interrelationships to be set up between images, text and program-control mechanisms.

Pending publication in *Perception and Psychophysics*,  
the paper "Efficiency of Graphical Perception"  
by Gordon E. Legge, Yuanchao Gu, and Andrew Luebker  
has been withdrawn from this *Proceedings*<sup>1</sup>

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<sup>1</sup>If copyright permission is obtained before printing, we will add this paper as an addendum.

